Center Independent Research & Development: JPL IRAD

Fast Optimal Motion Planning (FMP)

Completed Technology Project (2015 - 2017)

Project Introduction

Computationally-efficient, fast and real-time, and provably-optimal motion planner for systems with highly nonlinear dynamics that can be extended for cooperative path-planning of a large number of spacecraft in close proximity operation.

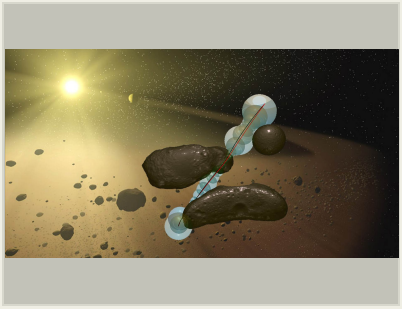
This effort will deliver a motion planning technology that is: 1) Fast & real-time: Allows reaction to environmental changes by re-planning fast and frequently; 2) Computationally efficient: Allows deployment on small spacecraft and resource constraint platforms; 3) Optimal (e.g. fuel, time): Allows resource limited missions even for highly nonlinear systems; 4) Capable of handling highly nonlinear dynamics, e.g. spacecraft with J2 effects, planetary helicopters; 5) Cooperative: Coordinated planning allows movement of many spacecraft in close proximity.

Anticipated Benefits

This technology significantly enhances the current state-of-the-art spacecraft and robotic motion planning methods, which cannot account for highly-nonlinear dynamics and do not have capability of coordinated path-planning for teams of vehicles in close-proximity.

This effort directly maps into JPL's strategic plan for increased autonomy of spacecraft, which can speed up the operations and science return, allows spacecraft to operate where human monitoring and command cannot reach, and reduce operations cost by reversing the many-to-one (human to spacecraft) operation model. It also provides a reliable autonomous path planning tool for teams of formation flying spacecraft in close proximity.

This technology and its capability of fast and light weight path-planning is directly of interest to a number of robotics applications such as DARPA's Fast Lightweight Autonomy challenge. The cooperative version of the algorithm is of interest in operation of swarms of autonomous vehicles such as teams of unmanned aerial vehicles.



Project Image Fast Optimal Motion Planning project provides tools for real-time motion planning for small spacecraft with limited computational capability.

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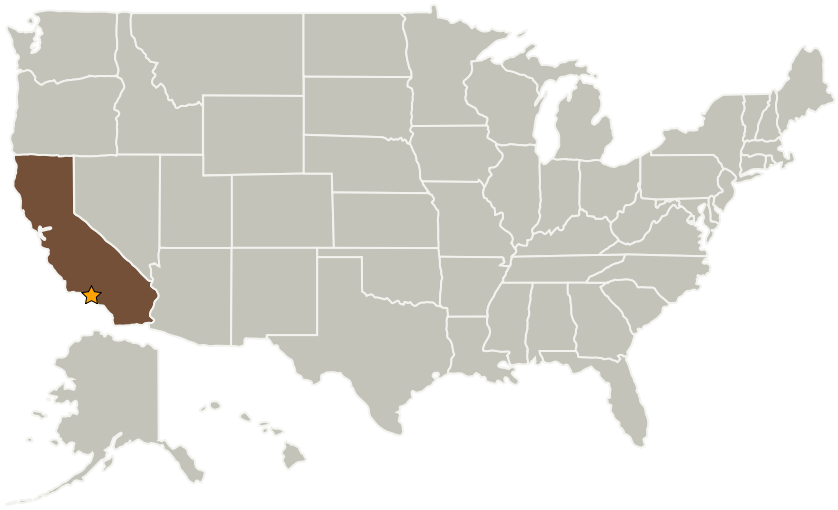
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Jet Propulsion Laboratory(JPL)	Lead Organization	NASA Center	Pasadena, California
California Institute of Technology(CalTech)	Supporting Organization	Academia	Pasadena, California

Primary U.S. Work Locations
California

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Jet Propulsion Laboratory (JPL)

Responsible Program:

Center Independent Research & Development: JPL IRAD

Project Management

Program Manager:

Fred Y Hadaegh

Project Manager:

Fred Y Hadaegh

Principal Investigator:

Amir R Rahmani

Co-Investigators:

Soon-jo Chung
Jean-pierre De La Croix

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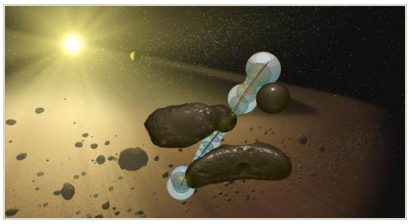
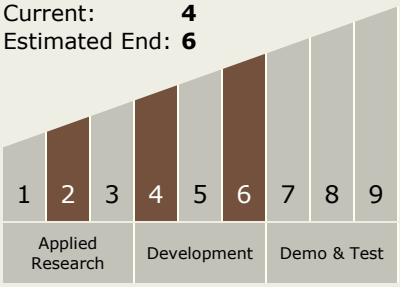
Images



Fast Optimal Motion Planning Project
Project Image Fast Optimal Motion Planning project provides tools for real-time motion planning for small spacecraft with limited computational capability.
(https://techport.nasa.gov/image/26101)

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **6**



Technology Areas

Primary:

- TX10 Autonomous Systems
  - TX10.2 Reasoning and Acting
    - TX10.2.3 Motion Planning